

For each of the following reactions, state whether a precipitate occurs. If it does, write the correct net ionic equation for the production of the precipitate.

- Sodium hydroxide + hydrochloric acid
no precipitate
- Barium chloride + sodium hydroxide
precipitate barium hydroxide: $\text{Ba}^{2+}_{(\text{aq})} + 2\text{OH}^{-}_{(\text{aq})} \rightarrow \text{Ba}(\text{OH})_{2(\text{s})}$
- Sodium chloride + copper nitrate
no precipitate
- Silver nitrate + sodium hydroxide
precipitate silver hydroxide: $\text{Ag}^{+}_{(\text{aq})} + \text{OH}^{-}_{(\text{aq})} \rightarrow \text{AgOH}_{(\text{s})}$
- Ammonia + sodium chloride
no precipitate
- Iron III nitrate + ammonia
precipitate iron III hydroxide: $\text{Fe}^{3+}_{(\text{aq})} + 3\text{OH}^{-}_{(\text{aq})} \rightarrow \text{Fe}(\text{OH})_{3(\text{s})}$
- Magnesium sulfate + barium chloride
precipitate barium sulfate: $\text{Ba}^{2+}_{(\text{aq})} + \text{SO}_4^{2-}_{(\text{aq})} \rightarrow \text{BaSO}_{4(\text{s})}$
- Zinc chloride + sodium carbonate
precipitate zinc carbonate: $\text{Zn}^{2+}_{(\text{aq})} + \text{CO}_3^{2-}_{(\text{aq})} \rightarrow \text{ZnCO}_{3(\text{s})}$
- Aluminium chloride + silver nitrate
precipitate silver chloride: $\text{Ag}^{+}_{(\text{aq})} + \text{Cl}^{-}_{(\text{aq})} \rightarrow \text{AgCl}_{(\text{s})}$
- Copper nitrate + ammonia
precipitate copper hydroxide: $\text{Cu}^{2+}_{(\text{aq})} + 2\text{OH}^{-}_{(\text{aq})} \rightarrow \text{Cu}(\text{OH})_{2(\text{s})}$
- Sulfuric acid + barium chloride
precipitate barium sulfate: $\text{Ba}^{2+}_{(\text{aq})} + \text{SO}_4^{2-}_{(\text{aq})} \rightarrow \text{BaSO}_{4(\text{s})}$

The following reactions involve a precipitate redissolving. Write an equation and explain:

- Sulfuric acid is added to the precipitate formed between ammonia and aluminium chloride
the ppt is aluminium hydroxide; it reacts with sulfuric acid to form soluble aluminium sulfate (this distinguishes it from lead as lead sulfate is insoluble but lead hydroxide is amphoteric)
$$2\text{Al}(\text{OH})_{3(\text{s})} + 3\text{H}_2\text{SO}_{4(\text{aq})} \rightarrow \text{Al}_2(\text{SO}_4)_{3(\text{aq})} + 3\text{H}_2\text{O}_{(\text{l})}$$
- Excess sodium hydroxide is added after a precipitate is formed in aluminium chloride and sodium hydroxide.
the aluminium hydroxide is amphoteric and reacting with excess hydroxide ions to form aluminate
$$2\text{Al}(\text{OH})_{3(\text{s})} + \text{OH}^{-}_{(\text{aq})} \rightarrow [\text{Al}(\text{OH})_4]^{-}_{(\text{aq})}$$
- Excess ammonia is added to the precipitate formed between ammonia and copper chloride.
because ammonium hydroxide solution contains NH_3 as well as NH_4^{+} and OH^{-} , when excess is added the concentration of NH_3 rises to displace the water molecules that are the normal ligands for copper in aqueous solution; the ammonia chelated copper complex is more soluble and dissolves forming the deep blue copper tetramine complex
$$\text{Cu}^{2+}_{(\text{s})} + 4\text{NH}_3 \rightarrow [\text{Cu}(\text{NH}_3)_4]^{2+}_{(\text{aq})}$$